CLAIMS

1. A method of iteratively detecting and decoding encoded and interleaved symbols transmitted on a transmission channel, these symbols being transmitted on the basis of a sequence of binary symbols, each sequence of received symbols comprising at least specific learning symbols, in addition to the data, hold and tail symbols, characterised in that it consists in:

- prior to any iteration,
  - running an initial linear estimation of the coefficients of the impulse response of the transmission channel $\hat{H}^{(!)}_{(z)}$ on the basis of the specific learning symbols transmitted;
- by iteration :
  - subjecting the equalization and decoding process to an iterative process of exchanging a priori information, firstly relating to the symbol bits from the decoding process in the case of the equalization process and, secondly, relating to the encoded bits from the equalization process in the case of the decoding process;
  - running an updated iterative re-estimation of the coefficients of the impulse response of the transmission channel on the basis of the information resulting from the iterative equalization and decoding process;
  - repeating the steps performed by iteration at the next iteration.

2. Method according to claim 1, characterised in that said iterative process of exchanging a priori

information consists in differentiating between the contribution of the transmission channel and the contribution of decoding, this differentiation consisting, firstly, in:

- subtracting from the sequence (S_1) of weighted outputs on equalized symbol bits, resulting from the equalization process, ~~said~~ a priori information ($S"_2$) on the symbol bits in order to generate an extrinsic sequence (S'_1);
- subjecting said extrinsic sequence (S'_1) to a de-interleaving process in order to generate a sequence of weighted inputs ($S"_1$) containing the information from the channel and the a priori information on the encoded bits emanating from the equalization;

and, secondly, in:

- subtracting from the sequences of weighted outputs (S_2) on decoded bits, resulting from the decoding process, said sequence of weighted inputs ($S"_1$) in order to generate a sequence of extrinsic information on decoded bits (S'_2);
- subjecting said sequence of extrinsic information on decoded bits (S'_2) to a re-interleaving process to generate said a priori information ($S"_2$) on the symbol bits.

3. Method according to claim 1 ~~or 2~~, characterised in that said equalization process is a Viterbi SISO MLSE equalization process with weighted inputs coupled with a re-estimation by an iterative EM process.

4. Method according to claim 1 ~~or 2~~, characterised in that the equalization process is a DDFSE process with

weighted outputs coupled with a re-estimation of the *bootstrap* type.

5. Method according to claim 1 ~~or 2~~, characterised in that the equalization process is a process of the GSOVA type coupled with a re-estimation of the *bootstrap* type.

6. Method according to claim 1, ~~2 or 4~~, characterised in that if said equalization process is an equalization process of the DDFSE type in which a single survivor per node is retained, it additionally consists in:

- prior to any iteration,
  - computing, from said initial linear estimation of the coefficients of the impulse response $\hat{H}_{(z)}^{(l)}$ of the transmission channel, a minimum phase filter $\hat{P}_{(z)}^{(l)}$ and an anticausal filter $\hat{Q}_{(z)}^{(l)}$ respectively, where $\hat{H}_{(z)}^{(l)} * \hat{Q}_{(z)}^{(l)} = \hat{P}_{(z)}^{(l)}$, the filter $\hat{P}_{(z)}^{(l)}$ being defined as a transmission channel with an initial minimum phase, then
- by iteration,
  - subjecting said sequence of received symbols to said equalization process, conditional on the values of the minimum phase filter $\hat{P}_{(z)}^{(l)}$ defined as a successive minimum phase transmission channel for the current iteration, and, on the basis of said updated linear estimation $\hat{H}_{m(z)}^{(l+1)}$, for the next iteration;
  - updating, for the next iteration, the minimum phase filter $\hat{P}_{(z)}^{(l+1)}$ defined as a successive minimum phase

channel and the anticausal filter $\hat{Q}_{(z)}^{(l+1)}$ associated with the latter.

7. Method according to claim 6, characterised in that the steps computing the filter $\hat{P}_{(z)}^{(l)}$, transmission channel with initial and respectively successive minimum phase and the anticausal filter $\hat{Q}_{(z)}^{(l)}$ associated with them are computed by the cepstre method.

8. Method according to one of the preceding claims, characterised in that said step consisting in running an updated estimation of the coefficients of the impulse response $\hat{H}_{(z)}^{(l+1)}$ for the next iteration consists in:

- subjecting said sequence of weighted outputs on decoded bits to an interleaving process;
- subjecting said flow of the sequence of re-interleaved weighted outputs to a hard decision in order to reconstitute the symbols received;
- subjecting the reconstituted received symbols to a linear pseudo-inversion process on all the reconstituted received symbols.

9. Method according to one of claims 1 or 2, characterised in that said step consisting in running an updated estimation of the coefficients of the impulse response of the transmission channel for the next iteration consists in applying an EM iteration using the weighted outputs on symbol bits produced by equalization in the running iteration and the running estimated value of the coefficients of the impulse response of the transmission channel $\hat{H}_{(z)}^{(l)}$.

10. System of detecting and iteratively decoding encoded and interleaved symbols on a transmission channel, these symbols being transmitted from a sequence of binary symbols, each sequence of received binary symbols comprising, in addition to the data, hold and tail symbols, at least specific learning symbols, characterised in that it comprises at least:

- equalization means (1) with soft inputs and outputs receiving said received symbols and emitting a sequence of weighted outputs on equalized symbol bits;
- means (2) for computing and iteratively exchanging a priori information, firstly on the symbol bits resulting from the decoded symbol bits in the case of the equalization process and, secondly, on the encoded bits resulting from the equalized symbol bits in the case of the decoding process;
- decoding means (3) with soft inputs and outputs receiving said a priori information on the encoded bits and emitting a sequence of weighted outputs on decoded bits resulting from the decoding process;
- means for (4) producing an updated iterative estimation of the coefficients of the impulse response of the transmission channel on the basis of the information resulting from the iterative equalization and decoding process.

11. System according to claim 10, characterised in that said means (2) for computing and iteratively exchanging a priori information comprise:

- first means (20) for subtracting from the sequence (S_1) of weighted outputs on equalized symbol bits said a

priori information ($S"_2$) on the symbol bits in order to generate an extrinsic sequence (S'_1);

- means (21) for de-interleaving said extrinsic sequence enabling said sequence of weighted inputs ($S"_1$) containing the information from the channel and the a priori information of the encoded bits from the equalization to be generated;
- second means for subtracting (22) from the sequence of weighted outputs on decoded bits (S_2) resulting from the decoding process said sequence of weighted inputs ($S"_1$) in order to generate a sequence of extrinsic information on decoded bits;
- means (23) for re-interleaving said sequence of extrinsic information on decoded bits, enabling said a priori information ($S"_2$) on the symbol bits to be generated.

12. System according to claim 10 ~~or 11~~, characterised in that said means (4) for running an updated iterative estimation comprise:

- means (40) for running an initial estimation of the coefficients of the impulse response of the transmission channel;
- means for running an updated iterative estimation of the EM type of the coefficients of the impulse response of the transmission channel.

13. System according to claims 10 and 12, characterised in that :

- said equalization means (1) are MLSE equalization means with soft inputs/outputs;
- said decoding means (3) are BCJR decoding means with soft inputs/outputs.

14. System according to claims 10 and 12, characterised in that:

- said equalization means (1) are DDFSE equalization means with soft inputs/outputs;
- said decoding means (3) are BCJR decoding means with soft inputs/outputs.

15. System according to claims 10 and 12, characterised in that:

- said equalization means (1) are GSOVA equalization means;
- said decoding means (3) are BCJR decoding means with soft outputs.

16. System according to claim 10 and one of claims 14 or 15, characterised in that said updated iterative estimation means (4) comprise:

- means (41) for re-interleaving the sequence (S_2) of weighted outputs on decoded bits resulting from the decoding process, emitting a sequence of weighted outputs on re-interleaved decoded bits;
- hard decision means (42) receiving the sequence of weighted outputs on re-interleaved decoded bits and emitting a sequence of reconstituted received symbol bits;
- means (43) for applying a linear pseudo-inversion on all the reconstituted received symbols, enabling an updated estimation of the coefficients of the impulse response of the transmission channel to be emitted.